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## Description

Cellular communications network with a search function

5 The invention relates to a cellular communications network with a search function.

Mobile radio systems that are intended for a relatively large number of subscribers are typically cellular,

10 i.e. the total area to be served by a network is divided into smaller radio cells, so-called communications cells. The smaller the individual cells are, the more mobile telephone subscribers can be supported with a limited frequency spectrum per area.

15 The present radio-frequency digital communications networks such as GSM 900 and GSM 1800 with very high subscriber numbers have small cell sizes with radii of a kilometer or less. The use of small cell sizes is also envisaged for a future UMTS mobile radio standard. It 20 is thus possible, by assigning a mobile telephone to a communications cell, to find the location the mobile telephone with a precision of a few hundred meters.

25 The invention is based on the object of proposing a positioning system for mobile telephones for use in emergencies such as accidents or for combating crime, in which the positioning process should be possible without assistance from the mobile telephone user.

30 The object is achieved with the cellular communications system defined in claim 1, in which the mobile telephone to be sought can be switched to a passive mode, in which it is not recognizable as a normal network subscriber and receives only a specific search 35 signal for this mobile telephone, and in answer to this emits a response signal, which is received by one or more base stations. As a result of the spatial distribution of the base stations that receive the response signal, the area in which the mobile telephone 40 is positioned can be determined.

The communications system according to the invention has the advantage that it allows a covert search for persons with a favorable cost/benefit ratio. The search 5 function can easily be integrated with software in existing or future mobile radio systems such as GSM networks and/or UMTS networks and be offered to a wide public as an additional service.

10 The invention likewise proposes a method for determining the position of a mobile telephone in a cellular communications system, and a mobile telephone for executing the search function. Advantageous developments of the invention are disclosed in the sub- 15 claims.

The mobile telephone can be switched by a user, preferably by means of an identification code (PIN), between the passive mode that allows only the search 20 function, and a normal conversation mode, and/or switched off completely. It is not possible for a user or caller to distinguish whether the mobile telephone is switched off or is in the passive mode that permits the search function. A covert search is thereby 25 enabled. The passive mode requires interaction with the network only for the search operation, so that the power consumption is lower than in the normal switched-on state with roaming, and the search function can therefore be maintained over a longer period.

30 It is optionally possible to switch the mobile telephone to normal operation on reception of the search signal, so that the sought person can communicate by radio with the searcher.

The search signal and the response signal can be encrypted, so that unauthorized persons can identify these signals only with difficulty, if at all.

- 5 The response signal can contain encrypted information about the locality of the mobile telephone, which information is received via sensors such as a microphone affixed to the mobile telephone.
- 10 In order to further reduce the energy consumption in which search mode, a periodic ready-to-receive state can be provided, so that the search signal is receivable for example for 10 seconds in each minute.
- 15 The invention is described in the following text with the help of a preferred embodiment, with reference to the accompanying single **Figure 1**, which shows schematically the structure of a communications system according to the invention.
- 20 The cellular communications system has a large number of communications cells 1, each of which has a base station 2 with transceiver facility. With suitable time and/or frequency division multiplex techniques, calls
- 25 can be made simultaneously in a single cell by several mobile telephones 5. The cell size is between a few kilometers and a few hundred meters or less in radius, depending on the user density.
- 30 The mobile radio network has a home location register 3, in which the mobile telephones of a network operator are registered, the call acceptance and assignment are controlled and the billing is carried out.
- 35 A mobile telephone according to the invention has, as well as the known operating states "off", in which the mobile telephone can receive no signals at all, and "on", when there is regular interaction with the communications network, and so-called roaming, i.e. the

present position of the mobile telephone is notified to the home location register, so that continuous availability for calls is ensured, a further operating state, referred to as the passive mode. In this, the 5 mobile telephone is not recognizable as a normal network subscriber, and no roaming takes place. The mobile telephone recognizes only a search signal specific to itself, and sends a short encrypted response signal in reply. Neither the user who is 10 holding the mobile telephone, nor a caller can find out whether the mobile telephone is in the passive mode or switched off. The mobile telephone accessible is only bringing the special search mode. The passive mode can be activated and deactivated again by the user, 15 preferably after entering an identification code (PIN).

Since, in the passive mode, there is no continuous interaction between the mobile telephone and the communications network, the mobile telephone's power 20 consumption is lower in passive mode than in the switched-on or standby operating mode. In order to reduce the power consumption further and thereby extend the operating time in the passive mode, an interval operating mode can be provided, so that the mobile 25 telephone is ready to receive the search signal for ten seconds in each minute, for example.

As soon as a mobile telephone is switched to the passive mode, this is stored in a memory 4 in the home 30 location register 3 together with its communications cell. No further information is subsequently available as to the cell in which the mobile telephone is located.

35 The search mode can be carried out only by a person with authorization for this, who proves his identity with an identification code, for example. These persons can be close relatives of the owner of the mobile telephone to be found, public authorities such as

police or public prosecutors, or else the employer of the mobile telephone's holder. As soon as the search process is initiated, the control device 6 linked to the home register 3 selects a number of base stations 2 for the first search. For this, the information on the last whereabouts of the mobile telephone before activation of the passive mode, stored in the memory 4, is preferably consulted. The selected base stations 2 then send a specific search signal for the sought mobile telephone 5. If the sought mobile telephone is within range of these base stations, it sends the encrypted response signal, which is received by one or more of the base stations. From the position of the base stations that receive the response signal, the position of the sought mobile telephone can be determined relatively precisely. At the same time, the intensity and arrival time of the response signal can also be used as parameters for position finding. If the base stations receive no response signal, the search operation is extended to a wider area, and repeated as necessary.

The response signal output by a mobile telephone is encrypted in duration and frequency in such a way that it can be identified only by a system that knows the response key. Other receivers see it only as noise. Misuse of the search function can thus be avoided.

The mobile telephone can also be equipped with sensors such as a microphone or a temperature sensor. In the response signal, encrypted information about the environment of the mobile telephone in the passive mode can then be transmitted, such as a noise, light/dark or the temperature, humidity or similar. These functions could be useful, for example, in finding kidnap victims.

A further variant of the invention is the provision of a mobile telephone for the passive mode only. It is

then possible to dispense with a keyboard or display as needed for the other mobile telephone functions. The passive mobile telephone can thus be made very small and light, and it does not need to have the usual form 5 for mobile telephones. It can be included disguised in other objects such as a printer, a clock or a pocket calculator.

10 The invention enables a search function for a mobile telephone, which can easily be integrated in existing and future mobile radio communications systems. A mobile telephone in the passive mode cannot be distinguished from one that is switched off. Because of the low energy consumption in the passive mode, this  
15 can be maintained over a long period.